Computer Information Center

Computation Department

LTSS Livermore Time-Sharing System

Part I: OCTOPUS

Chapter 7: VISUAL RECORDING EQUIPMENT

Paul E. Lund, et al.

November, 1970 Edition - 1

MASTER

Lawrence Radiation Laboratory
University of California/Livermore

DISTRIBUTION OF THIS DOCU [illegible]

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

LTSS-7

LIVERMORE TIME SHARING SYSTEM

PART I: OCTOPUS

CHAPTER 7: VISUAL RECORDING EQUIPMENT

EDITION 1

* * *

by PAUL E. LUND
LEE O. TENNANT

Systems Development Section
Computation Department

CAROLYN R. HUNT

Systems Operation Section
Computation Department

published by the

Computer Information Center
Computation Department
November, 1970

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

PREFACE

This chapter of the Livermore Time-Sharing system manual was written to give the user of the system a clearer understanding of the types of visual recording equipment available and to give some insight into what is involved in getting his output files processed.

The equipment and the configuration of the system has changed in the past and may change further in the future. It is hoped that this chapter can be updated to reflect any changes in equipment, configuration or "rules of the game" as the need arises.

P. L.

TABLE OF CONTENTS

Page

Preface iii

Introduction 1

Section 7.1: High-Speed Printers 3

- 7.1.1. The Radiation Printer 3
- 7.1.2. The CDC 501 Line Printer 6
- 7.1.3. The CDC 512 Line Printer 9
- 7.1.4. The CDC 1612 Line Printer 11
- 7.1.5. CDC 6600 Printer Files 12
- 7.1.6. CDC 7600 Printer Files 13
- 7.1.7. Printer File Formats 14

Section 7.2: Plotting Equipment 18

- 7.2.1. The dd80-C Display Device 18
- 7.2.2. DD80-C Command Structure 19
- 7.2.3. DD80-C File Format 23

References 27

ILLUSTRATIONS

Figure Page

7.1. The Radiation High-Speed Printer . . . 5

7.2. CDC 501 and CDC 1612 Printer Configurations 8

7.3. ASCII Codes for LRL Printers 17

7.4. ASCII Characters for the dd80-C Display Device 22

INTRODUCTION

When L.R.L. received its first CDC 6600 computer, the only visual recording equipment available to the user running on that machine was an on-line CDC 1612 line printer and the Radiation Printer. Each user could output his data directly to the 1612 or write his own magnetic tape for the Radiation Printer. It soon became obvious that the operating system had to take over those tasks in order to keep the output from getting mixed and to cut down on the number of short magnetic tapes being produced.

The second 6600 to arrive was equipped with an on-line CDC 501 line printer and a dd80-C display device. The 1612 and 501 printers were cabled so that both 6600's shared each printer. The 501 became Printer-1 and the 1612 became Printer-2.

CDC 501 printers arrived with the third 6600 and the first CDC 7600, and a 512 printer arrived with the second 7600. When the last CDC 3600 was removed, a second 1612 became available.

The present configuration is: the 6600-G has a 501 printer and a 512 printer; the 6600-L has a 501 printer, a 1612 printer, and the dd80-C; the 6600-M has only one 501 printer. The two 7600's share one 1612 printer.

A brief description of the hardware for the three kinds of line printers, for the Radiation Printer and for the dd80-C are discussed in this chapter. Following that, is a discussion of the output files and how these files are handled differently on the 6600's and 7600's. Finally, output file formats and procedures for naming output files are discussed.

Section 7.1: HIGH-SPEED PRINTERS

7.1.1. The Radiation Printer

The *Super Speed Printer,*[1] also known as the *Radiation Printer,* is a very fast off-line electrosensitive printer system built by Radiation, Incorporated, for the Lawrence Radiation Laboratory. (See Figure 7.1.) The printer accepts 6-bit ASCII data from prerecorded, odd parity magnetic tapes, and produces alphanumeric lines of characters on fan-folded pages. The printer uses an electrosensitive multistylus recording technique which eliminates the mechanical inertia of impact printers and produces immediately available dry output.

Characters are formed by dots from a 5 x 7 rectangular matrix of available dots. Sixty-two characters are available. The printer operates at a maximum instantaneous rate of thirty-thousand 120-character lines per minute (60,000 characters per second) when an 800 bpi tape is used. Each page consists of 64 lines of 120 characters per line (a total of 7680 characters). Characters are 0.100 inches high by 0.069 inches wide, spaced 10.75 characters per inch and 6.46 lines per inch. Thus, a full page occupies an 11.2" x 10.0" portion of a a 12" x 11" piece of paper.

High speed printing is attained by swiftly moving the recording paper under a closely spaced row of fixed styli. Styli are selected according to the character to be printed and energized with electrical pulses. Passing these pulses of current through the electrosensitive recording paper produces contrasting marks on the paper. Characters are formed by controlling the flow of electrons through the chemically impregnated paper, which reacts chemically or physically to cause a rapid and permanent color change in the compounds.

A paper transporting subsystem handles the paper supply so that the printer need not be interrupted for re-supply for a period of 45 minutes. Two rolls of paper can be handled (one active and one standby) by this mechanism.

Manual operation of the Radiation Printer is effected through the control panel; automatic printing control is produced by the commands on the magnetic tape.

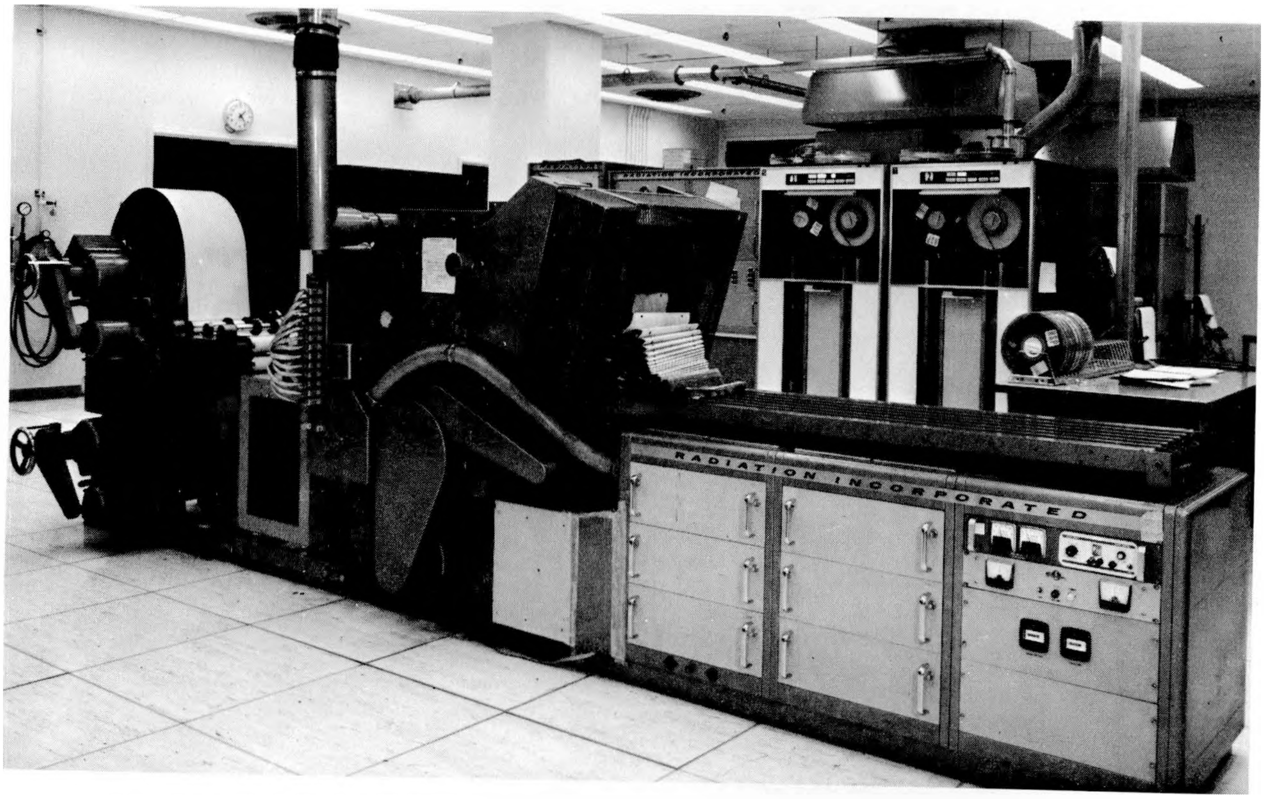


Figure 7.1. The Radiation High-Speed Printer

7.1.2. The CDC 501 Line Printer

The *Control Data 501-A Line Printer*[2] is an impact type printer that will print lines of 136 characters* at rates of 800-1000 lines per minute. Sixty-four printable characters are available on a print drum for each print position. The character set, with the corresponding ASCII code, is given in Figure 7.3.

The printer is controlled by a CDC 3659-A Line Printer Controller that assembles a line of data to be printed in a buffer memory, operates the Line Printer, and monitors the operation. The controller has two write controls, each of which is connected to one CDC 6600 or CDC 7600 dedicated PPU via a CDC 6681 or CDC 7681 Converter. A typical configuration is diagrammed in Figure 7.2.

The controller accepts data from the PPU until 136 characters are present in its buffer memory, or until the write operation is terminated. It then stops receiving data, and causes the line to be printed. The paper is then automatically advanced one line and the controller is ready to receive data for the next line.

The printer system is controlled by a series of function codes and an eight-level format tape. This tape may be used to provide any desired page format.†

A total of 28 *function codes* is available to control the printer. Eight *status reply codes* are available to monitor the operation of the printer.

A number of switches are available on the 501 printer to control its operation. Eight operator control switches are located on the control panel to the upper right of the printer.

---

* Only 120-character lines are used at L.R.L.

† Only Top-of-Form and Last-Line are used at L.R.L.

- The "Power On" switch/indicator applies power to the printer and is lighted when the power is on.
- The "Power Off" switch turns off the power.
- The "Start" switch/indicator enables the printing operation, and is lighted whenever the device is ready to print.
- The "Stop" switch/indicator disables the printer, and is lighted whenever the printer is not ready to print.
- The "Single Space" switch advances the paper one line.
- The "Page Eject" switch advances the paper to the top of the next page.
- The "Paper Out" indicator is lighted whenever the printer runs out of paper. (This also stops the printer.)
- The "Parity Err Override" switch/indicator permits the controller to ignore parity errors, and is lighted in this condition.

The start, stop, single space, and page eject switches are duplicated on an auxiliary control panel at the rear of the printer. Five print head controls are located inside the case.

- The "Form Positioning" control raises or lowers the position of the paper to adjust paper alignment.
- The "Motor Speed" switch determines the print rate to be 1000 or 667 lines per minute.
- The "Character Phasing" control makes adjustments for print quality.
- The "Paper Tension" control adjusts paper tension to allow different weights of paper.
- The "Penetration" control adjusts the hammer-print head gap to allow different weights of paper.

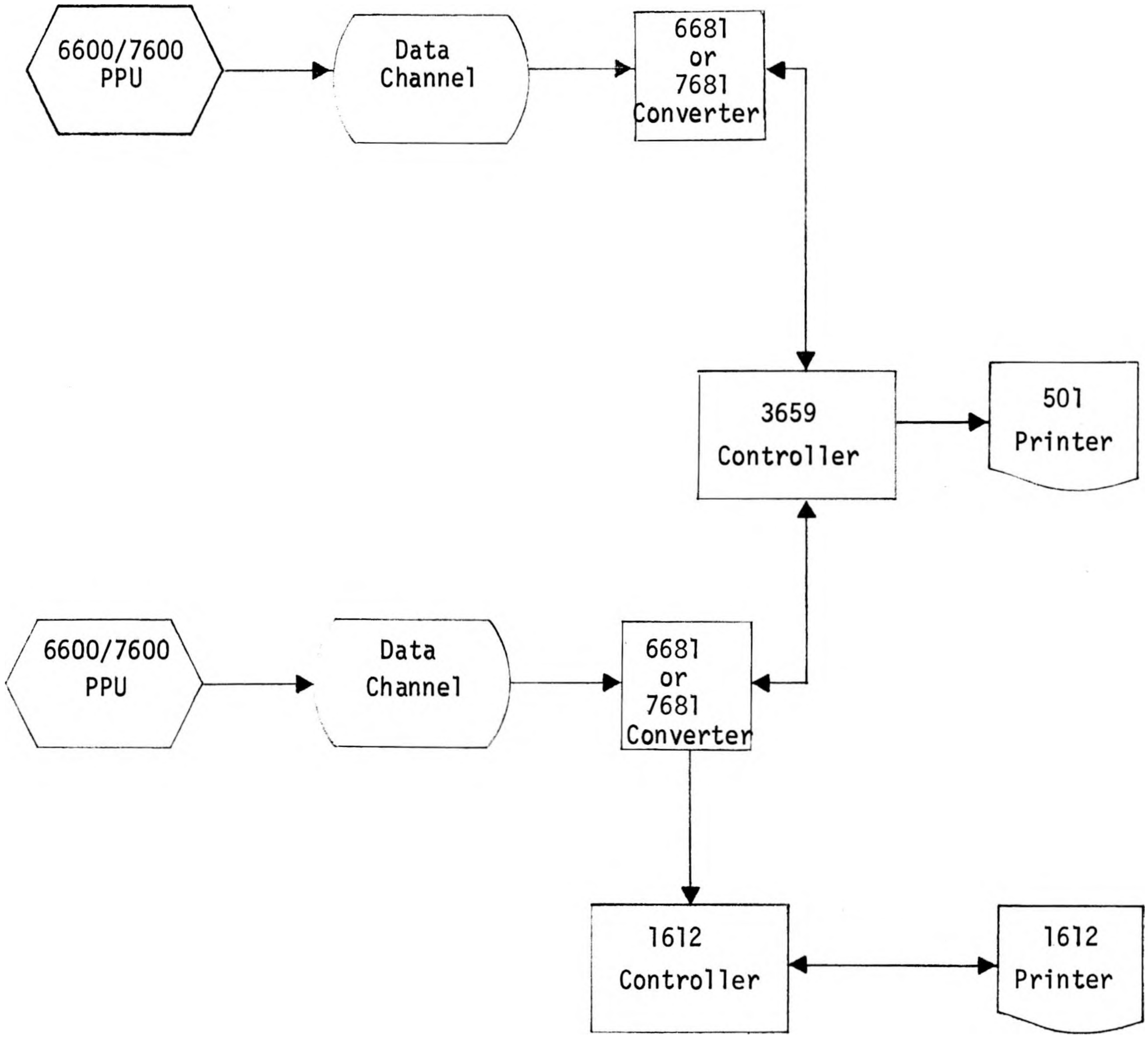


Figure 7.2. CDC 501 and CDC 1612 Printer Configurations

7.1.3. The CDC 512 Line Printer

The *Control Data 512 Line Printer*[3] is an impact type printer that will print lines of 136 characters* at a rate of 1200-2500 lines per minute. Sixty-four printable characters are available on the 288-character-position print train. The character set, with the corresponding ASCII code, is given in Figure 7.3.

The printer is controlled by a CDC 3555 Line Printer Controller that assembles a line of data to be printed in a core memory buffer, operates the line printer, and monitors the operation. The controller has one write control which is connected to a CDC 6600 dedicated PPU via a CDC 6681 converter.

The controller accepts data from the PPU until 136 characters are present in its buffer memory or until the write operation is terminated. It then stops receiving data, and causes the line to be printed. The paper is then automatically advanced one line and the controller is ready to receive data for the next line.

The printer system is controlled by a series of function codes and a twelve-level format tape that can contain formats for six line per inch and/or eight line per inch densities.† This tape may be used to provide any desired page format.

A total of 46 *function codes* is available to control the printer. Twelve *status reply codes* are available to monitor the operation of the printer.

The 512 printer has a core-type image memory that holds 288 ten-bit characters which correspond to the 288 characters on the print train. The memory contents exactly reflect the chain configuration and must be changed by software reloading if the train configuration is changed.

---

*Only 120-character lines are used at L.R.L.

†Only Top-of-Form and Last-Line at six lines per inch are used at L.R.L.

A number of control switches and indicators are available on the printer to control its operation.

- The "Power On" switch/indicator applies power to the printer, and is lighted when the power is on.
- The "Power Off" switch/indicator turns off the power.
- The "Start" switch/indicator enables the printer operation and is lighted when the printer is ready to print.
- The "Stop" switch/indicator disables the printer, and is lighted whenever the printer is not ready to print.
- The "Single Space" switch advances the paper one line.
- The "Page Eject" switch advances the paper to the next top-of-form position.
- The "6 Line/8 Line" switch/indicator determines the line density, and indicates the choice.
- The "Conn/Trans Par" double indicator shows that the printer is connected and/or that a transmission parity error has been detected.
- The "Error Override" switch/indicator permits the controller to ignore parity errors (for maintenance use), and is lighted in this condition.
- The "Mem Par/Mem Busy" double indicator shows if a memory buffer parity error has been detected or that the buffer is busy.
- The "Comp Fault/Print Error" double indicator shows that a compare fault or a print error has been detected.
- The "Fill Image/Cont Pwr" double indicator shows that image memory loading is enabled and/or that dc power is applied to the controller.

7.1.4. The CDC 1612 Line Printer

The *Control Data 1612-A Line Printer*[4] is an impact printer that will print lines of 120 characters at rates of 500-1000 lines per minute. Sixty-four printable characters are available on a print drum for each character position. The character set, with the corresponding ASCII code, is given in Figure 7.3.

The printer is controlled by a CDC 1612 Line Printer Controller that assembles a line of data to be printed in a buffer memory, operates the printer, and monitors the operation. The controller is connected to one CDC 6600 or CDC 7600 PPU via a CDC 6681 or 7681 Converter. A typical configuration is diagrammed in Figure 7.2 above.

The controller accepts data from the PPU until 120 characters are present in its buffer memory. It then stops receiving data, and causes the line to be printed. The paper is then automatically advanced one line and the controller is ready to receive data for the next line.

The printer is controlled by a series of function codes and an eight-level format tape. This tape may be used to provide any desired page format.*

A total of 15 *function codes* is available to control the printer. Two *status reply codes* are available to monitor the operation of the printer.

A number of switches are available on the 1612 printer to control its operation.

- The "Form Positioning" control raises or lowers the position of the paper.
- The "Motor Speed" switch determines the print rate to be 1000 or 667 lines per minute.

---

* Only Top-of-Form and Last-Line are used at L.R.L.

- The "Character Phasing" control makes adjustments for print quality.
- The "Paper Tension" control adjusts paper tension to allow different weights of paper.
- The "Penetration" control adjusts the hammer-print head gap to allow different weights of paper.
- The "Printer Ready" switch/indicator enables the printer, and is lighted whenever the device is ready to print.
- The "Single Line" switch advances the paper one line.
- The "Top of Form" switch advances the paper to the top of the next page.

7.1.5. CDC 6600 Printer Files

All files that are to be printed on any of the available printers must be processed by the operating system, FROST. Each such file must have a name beginning with the letter H, P, or L. This letter determines which printer is to be used: HSP, Printer-1, or Printer-2, respectively,

	6600-G	6600-L	6600-M
H	Radiation Printer	Radiation Printer	Radiation Printer
P	CDC 501	CDC 501	CDC 501
L	CDC 512	CDC 1612	(none)*

A significant difference between P and L files is the permitted number of pages. There is a 31 page limit to P files, and a 200 page limit to L files. If these limits are exceeded, the entire file is sent to the Radiation Printer after printing up to the page limit on the P or L printer.

---

*Such files are sent to Printer-1 and treated as P files.

On the CDC 6600's, H files are processed periodically by a portion of the system known as User-1, using a program called BINHSP. P and L files are handled by a FROST system overlay called up once a minute or on demand.

User-1 is a portion of the operating system identified by user number 999999. A problem program causes files to be printed by giving them to user 999999 with a FROST "Give Files to Other Users" system call.[5] Files may be given directly to User-1 by a user via utility routines GIVE,[6] OUT,[7] or ALLOUT.[8] For the format of printer files, see Section 7.1.7.

7.1.6. CDC 7600 Printer Files

All files that are to be printed on any of the available printers must be processed by the operating system, FLOE. Each such file must have a name beginning with the letter H, P, or L. This letter determines which printer is to be used: HSP, Printer-1, or Printer-2, respectively.

	7600-R	7600-S
H	Radiation Printer	Radiation Printer
P	CDC 1612	CDC 1612
L	(none)*	(none)*

There is a twenty page limit to P files. If this limit is exceeded, the entire file is sent to the Radiation Printer after printing up to the page limit on the P printer.

---

* Such files are sent to Printer-1 and treated as P files. The L printer designation is allowed only for consistency with the 6600 system.

On the CDC 7600's H files are processed on demand by a portion of the system known as User-1, using a program called BINHSP. P and L files are also processed by User-1, by a program called CARDREADER, which writes the file on the drum. A dedicated PPU then reads the file from the drum and prints it.

User-1 is a portion of the operating system identified by user number 999999. A problem program causes files to be printed by giving them to user 999999 with a FLOE "Give Files to Other Users" system call.[9] Files may be given directly to User-1 by a user via utility routines GIVE, OUT, or ALLOUT.

7.1.7. Printer File Formats

Each printer file is in Packed ASCII format. The last four words of the file are reserved, and cannot be used for data that is to be printed. The last three words must contain the identification that is to be used by User-1 to generate an identification page for the printed output. The fourth word from the end is used as a sentinel by User-1.

A printer file consists of lines of text, with special sentinels to indicate end-of-line, end-of-page, and end-of-file. Characters are coded in six-bit ASCII; the actual character printed by the individual printers for each code is indicated in Figure 7.3. (For all printers, except the Radiation Printer, the PPU converts the ASCII code to the BCD code accepted by the printer controller.)

A line of text consists of 120 characters (twelve computer words). However, twelve words need not be used for a text line that contains fewer than 120 characters; terminal blanks may be omitted to save file space. This means that a special sentinel must be inserted into the print file to indicate that the line is finished. This sentinel is an ASCII exclamation mark (!): 01 (octal). It should be the last character of the last data word of the line.

Lines are concatenated to form pages. A maximum of sixty lines of data per page is possible (7200 characters). However, pages of less than sixty lines may be printed by inserting a page-restore sentinel in the word following the last line of the page. This word consists of two blanks and eight exclamation marks: 00000 10101 01010 10101 (octal).

The file must be terminated by an end-of-file sentinel. This is a word containing one exclamation mark and nine blanks: 01000 00000 00000 00000 (octal). It should follow the last word of the last page of data, and must precede the last four words of the file.

For Radiation Printer files, User-1 will unpack the Packed ASCII file, fill out each short line with blank characters, and write the information on an odd-parity tape, one page at a time. (User-1 will also add two lines of security-level information to the top and bottom of each page, when necessary.) This odd-parity tape will later be taken to the Radiation Printer and printed.

A page consists of 7682 characters or less. Two 120-character lines of blanks or security-level information, from one to sixty 120-character lines of data, two more 120-character lines of blanks or security-level information, and the two extra characters (16 and 00 octal) cause a page restore on the Radiation Printer.

The printed output is preceded with four pages of identification, taken from the last three words of the file. A special code (56 octal) causes the pen on the printer to drop so that a line is drawn down the edge of the identification pages, making the printouts easier to separate.

For Line Printer Files, the PPU will unpack the Packed ASCII file, fill out each short line, convert the data from ASCII to BCD and send the data line to the PPU Controller for printing. This output is also preceded by an identification page.

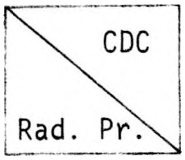
After each file has been processed by User-1, it is overwritten with a disc pattern and destroyed.

If the name of an H file consists of ten characters, and is of the form

```
H0NNNNNNNN
H1NNNNNNNN
.
.
.
HXNNNNNNNN
```

(where "NN...N" represents a string of characters) then User-1 will assume that a *family* of files exists. The files will be ordered by the second character of the file name (0, 1, ...); the last file in the family has an X in this character position. The family will be printed as one file, with no intermediate identification pages. If a family situation occurs, but the final file does not arrive at User-1 for a period of about half an hour, the incomplete family will be processed as described.

	0	1	2	3	4	5	6	7
0	(blank)	↓ ∇	≡ η	‡ □	$	% π	^ Σ	≥ ∿
1	(	)	*	+	,	-	.	/
2	0	1	2	3	4	5	6	7
3	8	9	:	; Δ	<	=	>	≤ α
4	¬ ρ	A	B	C	D	E	F	G
5	H	I	J	K	L	M	N	O
6	P	Q	R	S	T	U	V	W
7	X	Y	Z	[	⌣ λ	]	↑ ^	→



Each box defines the character printed on the Radiation Printer, CDC 501 Printer, CDC 512 Printer, and CDC 1612 Printer when the corresponding ASCII code is generated by the user. When these codes differ, the distinction is indicated by subdividing the box as indicated. Thus, a "54" code will cause the character "L" to be printed on all three printers, while a "37" code will generate an "α" on the Radiation Printer and a "≤" on the CDC printers.

NOTE: An ASCII 01 will appear as a blank if it is the last character in a word.

Figure 7.3. ASCII Codes for LRL Printers

7.2. PLOTTING EQUIPMENT

7.2.1. The dd80-C Display Device

Cathode ray tube output generated on the CDC 6600 and CDC 7600 computers is recorded on a Data Display Model dd80-C through the 6600-L computer. This system consists of a Display Controller, a Display Console, a Microfilm Recorder, and a Motor Generator.

The controller, used to drive the Microfilm Recorder and the Display Console, accepts data and commands from a CDC 6600 slave PPU in 36-bit *display words*. It contains a symbol generator, a vector generator, control logic, and digital-to-analog conversion circuits.

The display console contains a 16-inch CRT that provides the user with a visual display of his data. The device receives analog signals from the controller, amplifies them, and applies the result to the CRT deflection plates to perform the actual plotting. The tube contains a medium persistence phosphor, so the display remains visible for only a short time unless it is continuously refreshed.

The microfilm recorder contains a 5-inch precision CRT and a 35 mm recording camera. Data is received, amplified, displayed on the CRT, and photographed by the camera. The film is developed and printed at a later time.

The electron beam may be positioned at any desired point on a 1024 x 1024 square coordinate grid. These *raster points* are numbered 0 to 1023, reading left to right and bottom to top. Any of the following operations may be performed:

- Position the beam
- Plot a point
- Plot a single character
- Sweep a line to a given point
- Plot a string of characters
- Advance the frame
- Load a dash pattern into a dash register

Points, lines, and characters may be plotted at high or low intensity; characters may be generated in any of four sizes, two orientations, and two type faces. The character set includes 122 characters.

7.2.2. dd80-C Command Structure

Two plotting modes are available on the dd80-C. In the *plot mode*, each 36-bit instruction word specifies a single command to the device. In the *tabular mode*, each instruction word specifies six 6-bit characters.

In the plot mode, the particular action to be performed is specified by a 3-bit operation code in bits 27-29 of the instruction word. Six operation codes are available.

Code	Operation
0	Plot a single character
1	Position the beam or plot a single point
2	Draw a vector
3	Set tabular mode
4	Advance the frame
5	Load a dash pattern

In the charts below, several abbreviations are used. These are defined as follows:

. O Orientation

O = 0 for horizontal orientation,
O = 1 for vertical orientation.

. T Type face

T = 0 for roman type,
T = 1 for italic type.

. P Point plotting

P = 0 to suppress plotting,
P = 1 to plot.

. I Intensity

I = 0 for low intensity,
I = 1 for high intensity.

- S Size
  - S = 0 for miniature characters,
  - S = 1 for small characters,
  - S = 2 for medium characters,
  - S = 3 for large characters.
- C Case
  - C = 0 for upper case,
  - C = 1 for lower case.
- X,Y Coordinate positions, in raster points
  - $0 \leq X, Y \leq 1023$
- - - . Dashes, indicating bit positions that are not used for this command.
- 0 Zero, indicating bit positions that must be set to zero.

Plot character. This command is used to plot the character in field A at point (X,Y) using the specified size and case and the current setting of orientation, type face and intensity.

30			24		18 12		6 0
A A A A A A	0 0 0	S S	C	- -	X X X X X X X X X X	- -	Y Y Y Y Y Y Y Y Y Y

Position beam. This command is used to position the beam at point (X,Y), to set O, T, and I, and (optionally) plot a point at the specified intensity.

				30			24		18 12		6 0
- -	O	T	P	I	0 0 1	- -	-	- -	X X X X X X X X X X	- -	Y Y Y Y Y Y Y Y Y Y

Draw vector. This command will draw a vector from the current setting of (X,Y) to the specified setting of (X,Y) using the specified intensity.

	30		24	18 12		6 0
- - - - -	I	0 1 0	- - - - -	X X X X X X X X X X	- -	Y Y Y Y Y Y Y Y Y Y

Set tabular mode. This command sets values of orientation, type face, intensity, size, and case. Subsequent instruction words are interpreted as tabular mode characters containing six 6-bit characters per word until a 02 (octal) character is encountered. The first character in the string will be centered at (X,Y).

				30			24		18 12		6 0
- -	O	T	-	I	0 1 1	S S	C	- -	X X X X X X X X X X	- -	Y Y Y Y Y Y Y Y Y Y

Advance frame. This command will advance the film in the camera one frame.

	30	24 18 12 6 0
- - - - - - -	1 0 0	- -

Load dash pattern. This command will load a dash pattern from the bits specified in field X. The dash pattern will be automatically restored to 1777 (octal) upon exit from tabular mode or when manually reset.

	30	24	18 12	6 0
- - - - - - -	1 0 1	- - - - - -	X X X X X X X X X X	- - - - - - - - - - - - - -

Tabular mode. In tabular mode, each instruction word is considered to be six 6-bit characters. The characters plotted are illustrated in Figure 7.4. There are three special control characters, available in both upper and lower case.

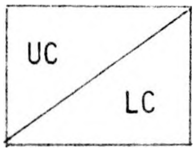
01	No operation.
02	Exit to plotting mode. (Ignore the rest of the word.)
03	Read the next six bits as a control word.

The control word after a 03 symbol code is interpreted as follows. If bit 5 is a zero, the character has six fields.

5	4	3	2	1	0
0	C	CR	T	-	I

(CR = carriage return)

	0	1	2	3	4	5	6	7
0	(blank) ≤				$ ≡	% Σ	& ^	' ∨
1	(α	) β	* γ	+ δ	, ε	- ∿	. ≥	/ Θ
2	0 Δ	1 ∇	2 λ	3 μ	4 ν	5 ⊂	6 ⊃	7 π
3	8 ρ	9 σ	: τ	; ∂	< φ	= ‡	> ψ	? ω
4	@ ∫	A a	B b	C c	D d	E e	F f	G g
5	H h	I i	J j	K k	L l	M m	N n	O o
6	P p	Q q	R r	S s	T t	U u	V v	W w
7	X x	Y y	Z z	[{	\ |	] }	↑ ↓	← →



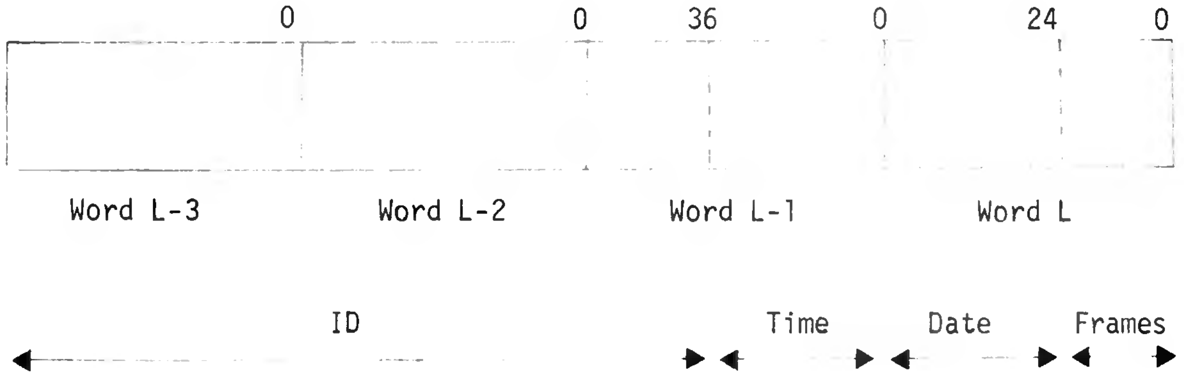
Each box defines the character plotted on the CRT when the corresponding BCD code is generated by the user. Upper case (UC) codes are indicated at the upper left of each box, and lower case (LC) codes are at the lower right. Codes 01, 02, and 03 are reserved control characters.

Figure 7.4. ASCII Characters for the dd80-C Display Device

If bit 5 is a one, an action similar to a typewriter tab is performed. Thirty-two evenly spaced tab positions are available across the grid; bits 0-4 specify which is to be used.

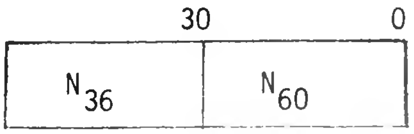
7.2.3. dd80-C File Format

The following information describes the conventions developed at L.R.L. for using the dd80-C. For normal production output, instruction words are accumulated on disc in special-format files for the dd80, known as "D-files." Each D file is initially 50,000 (decimal) words long (but may be shortened when the file is completed). The last four words of each file contain identification information.



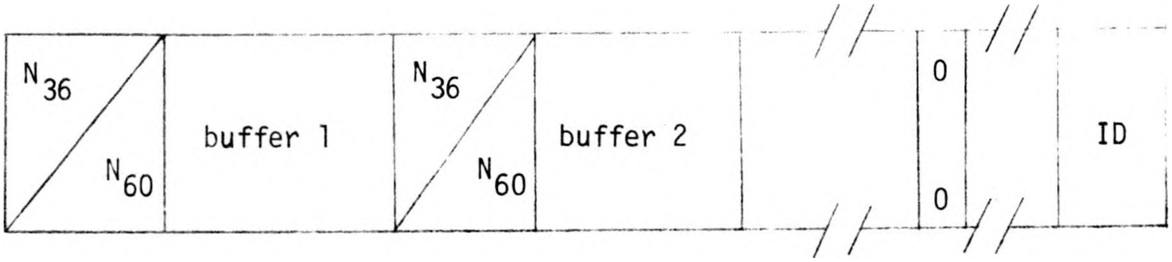
The first field contains 24 characters of identification (name and box number) for the plotted output. The second field specifies the time that the file was generated, in ASCII. The next field specifies the machine and date, also in ASCII. The last field contains the integer cumulative number of frames in the job.

The file consists of a number of buffers preceded by pointer words. The pointer word specifies the number of 36-bit instruction words (N_{36}) and the number of 60-bit machine words (N_{60}) in the following buffer. A pointer word of zero signifies the end of the plot information.



These quantities are related by

$$N_{60} = (N_{36} *3 - 1) / 5 + 1 .$$



The first buffer of each file contains two pages of identification, even though the job may use more than one file. The first buffer is normally plotted only for the first file of a family.

D-files are given to User-1 (User 999999) as they are completed and accumulated on disc until the end of the job. They are then written on tape by a User-1 routine called CRTOUT. At a later time, the tapes are read on the CDC 6600-L computer (to which the dd80 is connected) by a User-1 routine called DD80 and plotted on the dd80-C.

If more than one file is required for a job, up to ten files are accumulated as a family. The file names are ten characters long and begin with "D". The last eight characters are randomly chosen and are the same for all files in the family. The second character is a sequence character. The last file of the family is indicated by an "X" in the second character position.

D0NNNNNNNN
D1NNNNNNNN
.
.
.
DXNNNNNNNN

Not all plotting is done via the User-1 method described above. It is possible for a CDC 6600-L user to do on-line plotting. The user generates his buffer and sends it directly to the dd80 — monitor, camera, or both. The picture can be sustained by the appropriate use of IOD repeat fields, as described in reference 5.

REFERENCES

1. *Final Handbook - Super Speed Printer*, Radiation Systems Division, Radiation Incorporated, Melbourne, Florida (May, 1964).

2. *Control Data 501 High Speed Line Printer Reference Manual*, Control Data Corporation, St. Paul, Minnesota, CDC Publication Number 40805000 (May, 1965).

3. *Control Data 3555 Line Printer Controller Reference Manual*, Control Data Corporation, St. Paul, Minnesota, CDC Publication Number 60231300 (July, 1969).

4. *Control Data 6000 Series Computer Systems Peripheral Equipment Reference Manual*, Control Data Corporation, St. Paul, Minnesota, CDC Publication Number 60156100 (1969).

5. Pierre Du Bois and J. Dennis Lawrence, *Livermore Time Sharing System: Chapter 9, 6600 System Calls and I/O Requests*, Lawrence Radiation Laboratory, Livermore, California, Computer Information Center, CIC LTSS-9 (May 27, 1969).

6. D.W. Thompson, *Utility Routine GIVE*, Lawrence Radiation Laboratory, Livermore, California, Computer Information Center, CIC UR-309 (in preparation).

7. D.W. Thompson, *Utility Routine OUT*, Lawrence Radiation Laboratory, Livermore, California, Computer Information Center, CIC UR-404 (in preparation).

8. D.W. Thompson, *Utility Routine ALLOUT*, Lawrence Radiation Laboratory, Livermore, California, Computer Information Center, CIC UR-405 (January 15, 1970).

9. Pierre Du Bois, Harriet Coverston, and David Storch, *Livermore Time Sharing System: Chapter 10, 7600 System Calls and I/O Requests*, Lawrence Radiation Laboratory, Livermore, California, Computer Information Center, CIC LTSS-10 (January 26, 1970).